
Space Weather Technical Forecast

Issued on Sunday, 16 June 2024 at 12:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

We are aware of some disruption to data flow from the Space Weather Prediction Centre. As a result, our Alerts and Warnings service may experience delays or contain incomplete data.

Space Weather Forecast Headline: Isolated M-class flares (R1-R2 radio blackouts) likely throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been low, with peak activity in the last 24hrs a C7.1 flare peaking at 15/2323UTC from AR3712 in the southeast.

There are currently seven sunspots on the disc. The most complex groups all lie in the eastern solar hemisphere, and foremost amongst these is AR3712. This region contains multiple small delta spots, and has continued to see proliferation of its intermediate spots as well as increasing in overall area in recent hours. Also of note is AR3716 in the northeast, which has also developed intermediate spots to become a compact group and continues to grow in size. The other regions on the disk appear generally stable or are in decline.

A faint CME observed on LASCO-C2 imagery leaving the southwest disk approximately 16/0720 UTC remains under investigation, otherwise no other Earth directed CMEs were in evidence in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE at L1, erratically declined from CME arrival early on the 15 Jun, generally averaging around 380-420 km/s but with brief peaks of 450-470 km/s recorded. Density fell to below average levels. The Interplanetary Magnetic Field (IMF), Bt, was initially moderate after the CME arrival, with a maximum value of nearly 16nT, but declined fairly steadily to approach weak levels by the end of the period. The north-south component, Bz, also increased to moderate levels, ranging between +13 and -10nT following the CME onset, but steadily moderated to become weakly positive by the end of the period. Phi angle was mostly negative (towards the Sun), but did experience some isolated positive (away from the Sun) intervals at times. Geomagnetic activity reached G1 Minor Storm (Kp5) levels for the 15/1200-1500 period, before steadily reducing to become Unsettled to Active (Kp3-4) and then Quiet (Kp1-2) to end the period.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained below the S1 threshold and is now very close to resting Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was mainly at Normal Background levels, with the associated 24-hour fluence well below Active. Observed fluence at 16/0001UTC was 1.0e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Isolated M-class flares are likely, with a slight chance of isolated X-flares. This risk primarily from AR3712.

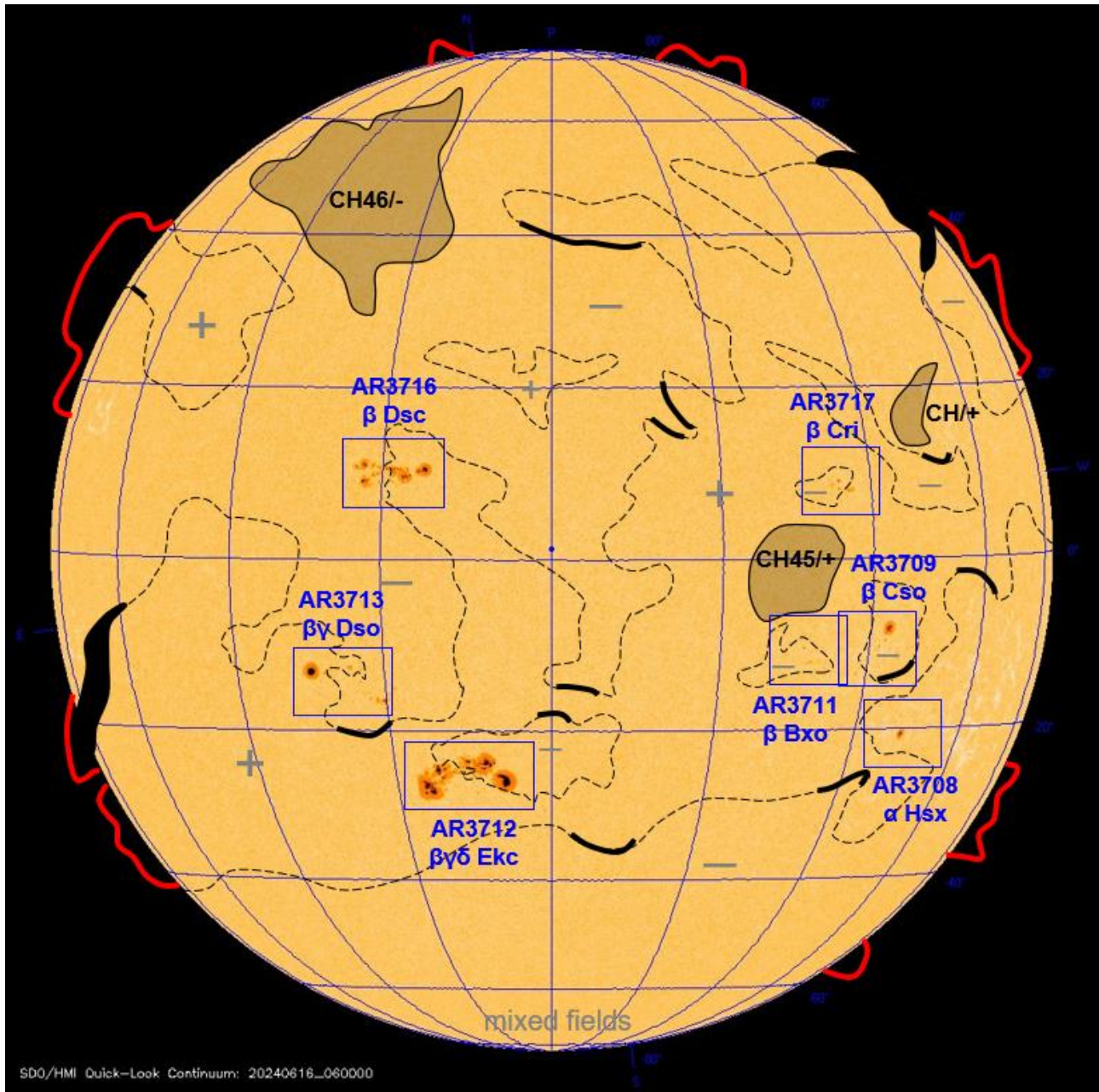
Solar Wind / Geomagnetic Activity: The solar winds are currently declining from recent CME enhancement, likely around 380-400 km/s, although recent ACE/DSCOVR data gaps mean accurate assessment is difficult. Positive corona hole enhancement possible though the period, chiefly associated with CH45/+, which is forecast to connect with Earth into days 2 and 3 (17-18 June).

Geomagnetic activity expected to remain at generally Quiet to Unsettled levels (Kp2-3), but with the risk of Active (Kp4) intervals into the UTC working week on arrival of any fast wind from CH45/+.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background levels, with just a slight but increasing chance of reaching S1 levels following any significant flares.

High energy electron flux is forecast to persist at predominantly Background levels, and the associated 24-hour fluence is expected to remain below the Active threshold.

Figure 1. Solar Analysis Valid 16/0600 UTC.



Key: Filament —, Prominence —, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No CMEs currently feature in the forecast.

The solar winds are currently declining from recent CME enhancement, likely around 380-400 km/s, although recent ACE/DSCOVR data gaps mean accurate assessment is difficult. Positive corona hole enhancement possible though the period, chiefly associated with CH45/+, which is forecast to connect with Earth into days 2 and 3 (17-18 June). This feature is not recurrent and is therefore something of an unknown quantity, however due to our proximity to the solstice and CH45's limited visual (AIA211) size, slightly elevated solar wind speeds of 400-500 km/s are considered most likely, likely persisting into day 4 (19 Jun).

Geomagnetic activity expected to remain at generally Quiet to Unsettled levels (Kp2-3), but with the risk of Active (Kp4) intervals into the UTC working week on arrival of any fast wind from CH45/+.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	1	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

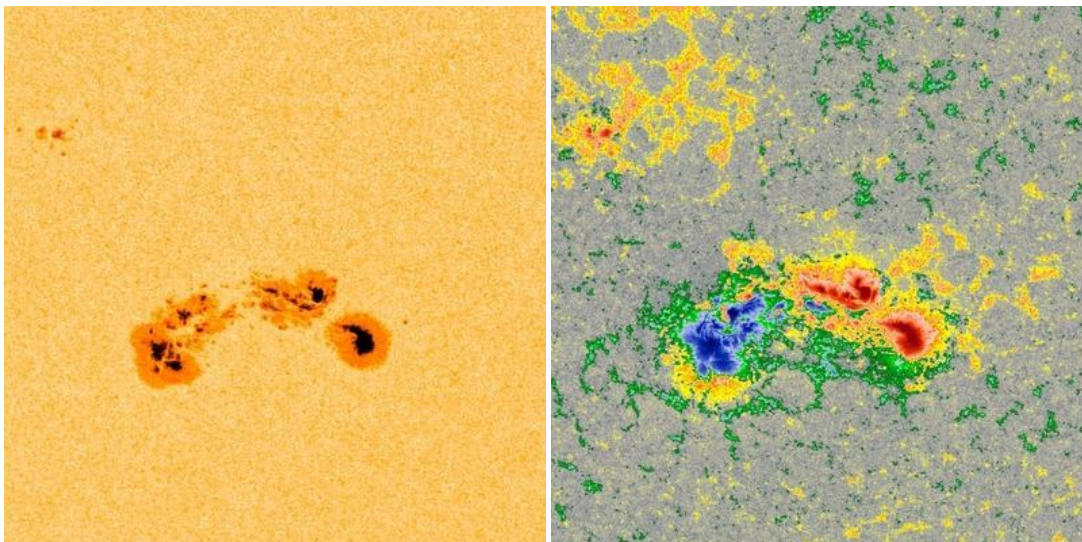
Radio Blackouts - X-Ray Flares:

The chances of significant flares looks to be primarily tied to the large AR3712, and to a lesser extent AR3716, with these two regions undergoing significant growth phases in recent days. Both of these sunspot groups now present as having 'compact' Zurich classifications, while AR3712 retains multiple small Mt Wilson delta spot. Other regions on the disk appear generally stable or are in decline, with the majority of flare activity in the past 24 hours emanated from one of these three regions, particularly AR3712.

Isolated M-class flares are viewed as likely going forward, with a slight chance of isolated X-flares primarily from AR3712. No significant sunspot regions are expected to either arrive or depart the visible disk during the period, and the risk is therefore held constant for now, pending further evolutions.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	70	70	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 2: Latest HMIIF/HMIBC imagery for AR3712, small delta spot regions visible



Solar Radiation Storms - (High Energy Protons):

High energy proton flux has been reverting to resting Background levels as recent enhancement has declined. In terms of the future risk, the most significant regions on the visible disc are currently in the eastern solar hemisphere. The daily risk of surpassing S1 is therefore low but shows a slight increase towards the end of the period as AR3612 begins to move into the western hemisphere of the visible disc into days 3-4 (18-19 Jun).

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	10	10	15	15
Very Active	$\geq \text{S3}$ *	No	1	1	5	5
* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux is expected to persist at mainly Background levels for much of this period, although some diurnal Moderate flux values are likely. This particularly later in the period following any enhancement provided by positive coronal hole influence into the period.

The associated 24-hour fluence is expected to remain below the Active threshold ($1\text{e}8$ integrated pfu) but with a rising trend possible later in the period. MOSWOC REFM considered to provide reasonably good guidance in the near term.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	10	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM output

